

# Epicardial stenosis severity does not affect minimal microcirculatory resistance

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# Epicardial Stenosis Severity Does Not Affect Minimal Microcirculatory Resistance

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## Background

Recently, we introduced an invasive index of microcirculatory resistance (IMR) calculated by the product of distal coronary pressure ( $P_d$ ) and thermodilution-derived mean transit time ( $T_{mn}$ ) measured at hyperemia:  $IMR = P_d \cdot T_{mn}$ .

In the absence of epicardial stenosis, myocardial flow is equal to coronary flow, and IMR correlates well with true myocardial resistance. In the presence of a stenosis however, myocardial flow is not only determined by coronary flow but also by collateral flow. In such a case, IMR (and comparable indices of microvascular resistance) can be calculated reliably by incorporating wedge pressure ( $P_w$ ):

$$IMR = P_a \cdot T_{mn} \frac{P_d - P_w}{P_a - P_w}$$

The aims of this study were to investigate the feasibility of determining IMR in humans and to test the hypothesis that microcirculatory resistance is independent of the presence of a stenosis.

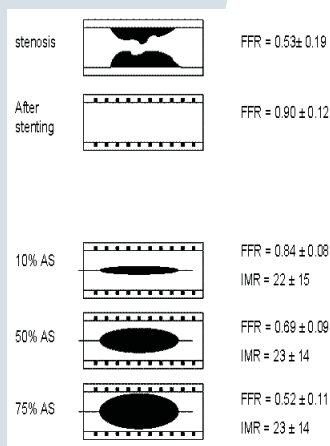


Figure 1: Schematic representation of the different steps of the protocol and corresponding values of FFR and IMR. AS, area stenosis; FFR, fractional flow reserve; IMR, index of microvascular resistance.

## Methods

30 patients referred for stenting of a coronary artery stenosis were studied. Using a pressure/temperature guidewire, the lesion was stented and during balloon occlusion, coronary wedge pressure was measured. After stenting, a short balloon with a diameter of 1.0 mm smaller than the deployed stent was introduced into the stented segment and inflated with increasing pressures, creating 3 stenoses with increasing severity of 10%, 50% and 75%, respectively.

At each degree of stenosis, fractional flow reserve (FFR) and IMR were measured, using intravenous adenosine for steady state hyperemia.

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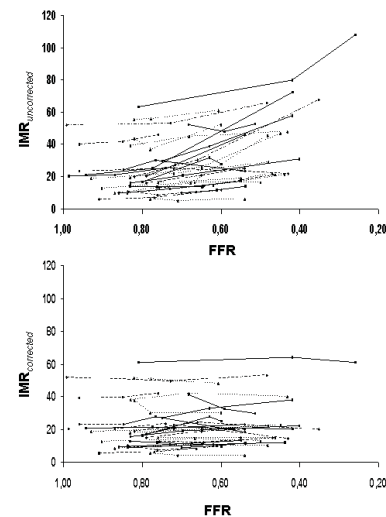


Figure 2: Relation between microvascular resistance and epicardial stenosis severity without correcting for collateral flow (upper panel) and with correction for collateral flow (lower panel).

## Results

90 measurements of IMR were done in 30 patients. When IMR was not corrected for  $P_w$ , an apparent increase in microvascular resistance was observed with increasing stenosis severity (IMR = 24, 27 and 37 U for the 3 different degrees of stenosis,  $p < 0.001$ ). In contrast, when taking into account collateral flow by incorporating  $P_w$  as indicated above, IMR did not change with stenosis severity (IMR = 22, 23 and 23 U respectively,  $p = 0.28$ ).

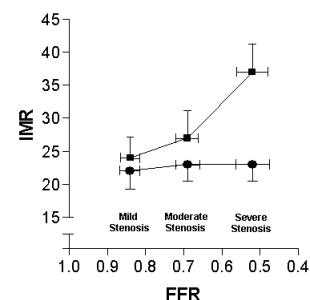


Figure 3: The relationship between microvascular resistance (IMR) and stenosis severity (expressed by FFR) when collateral flow is taken into account (dots) and when collateral flow is neglected (squares).

## Conclusion

- (1) Guidewire-based assessment of microvascular resistance by IMR is feasible in humans during PCI.
- (2) Minimal microvascular resistance, if calculated appropriately, is independent of epicardial stenosis severity.